Chapter Three: Contents

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Chapter Three—Module Testing and Calibration

The Light-Duty Vehicle (LDV) dynamics model was calibrated by forcing approximate agreement between the modeled and actual average $v \cdot A$ product for each third of the vehicle flux for an uncongested freeway, a moderately congested freeway, a fast arterial leaving a signal, and a fast arterial approaching a signal. For each trajectory in the original dataset, we calculated 4000 trajectories—beginning with random offsets within the first second of travel and the first 7.5 meters of travel—and used the result for the comparisons. For both the model and the actual data, we normalized the results to a single trajectory; that is, we made trajectory-averaged comparisons. Agreement was forced for both the fraction of the vehicles undergoing high power and the fraction undergoing hard braking for each third of the estimated vehicle flux.

For the modeled part of the comparison, we examined Traffic Microsimulator output from similar circumstances that gave a speed comparable to that of the freeway traffic and gave comparable speeds over the first three segments for the fast arterial. In a similar fashion, we used a dataset that gave comparable speeds over the end of an arterial approaching a signal. This calibration is only approximate because the speed gradients for the slowest, intermediate, and fastest thirds of the fluxes in the microsimulation are not necessarily the same as in the measured data.

The calibration for on-ramp driving was more complicated because the measured data in the California on-ramp study consisted of sets of joint distributions of speeds and accelerations rather than trajectories. The first step was to start with a uniform speed distribution and use the joint-distribution of speeds and accelerations to construct trajectories over the distance along the on-ramp that was monitored. We then calculated the speed distribution over the entire length associated with each starting speed. We used a non-negative, least square solver to estimate what initial speed distribution would be required to produce a speed distribution over the length that was similar to the measured one. Unfortunately, the measured trajectories used to construct the joint distribution of speeds and accelerations were not the same length for all vehicles. Consequently, on some of the on-ramps, the procedure produced strange initial speed distributions that were rejected. However, the Lomas on-ramp in southern California did produce reasonable initial speeds and was used to calibrate the parameters for on-ramps.

We did two types of comparisons:

- with emission arrays, and
- with trajectories passed through the CMEM1.2 code.

We used emission arrays for freeways where we don’t expect to have significant history effects, and we also used the emission arrays for the on-ramp case where the history effects would depend on the assumptions used to construct the trajectories from the joint distribution of speed and power. In these situations, we constructed several thousand trajectories beginning with random offsets within the first second of travel and the first 7.5 meters of travel. The resulting joint distribution of speeds and speed-acceleration products was used with the emission arrays to estimate the emissions for each trajectory. The emissions were averaged over all trajectories to produce the “trajectory implied emissions” that are compared with the modeled emissions.

For traffic on arterials either leaving a signal or approaching a signal, we used the original trajectories with the CMEM1.2 model to estimate the emissions. When the emissions were averaged over all of the trajectories, they were compared to modeled emissions.